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206. Proposed by W. J. GREENSTREET, A. M., Editor of The Mathematical Gazette, Stroud, England.

$ABCD$  is circumscribed by a circle center  $O$ , and it circumscribes a circle radius  $r$ . The perpendiculars from  $C$  on the sides are  $x, y, z, u$ . Show that  $\frac{1}{2}AC.BD = r\Sigma x$ .

Solution by G. B. M. ZERR, A. M., Ph. D., Parsons, W. Va.

The problem should read "the perpendiculars from  $O$ " instead of "the perpendiculars from  $C$ ".

Let  $a, b, c, d$  denote the sides  $AB, BC, CD, DA$ , respectively;  $x$  the perpendicular on  $a$ ;  $y$ , on  $b$ ;  $z$ , on  $c$ ;  $u$ , on  $d$ ;  $R$ =circum-radius.

Then  $x = \sqrt{(R^2 - \frac{1}{4}a^2)}$ . Now  $R = AC/2\sin B$ .

$$AC^2 = a^2 + b^2 - 2abc\cos B = c^2 + d^2 + 2cd\cos B.$$

$$\therefore x = \frac{1}{2\sin B} \sqrt{(AC^2 - a^2 \sin^2 B)} = \frac{b - a\cos B}{2\sin B}, \quad y = \frac{a - b\cos B}{2\sin B},$$

$$z = \frac{d + c\cos B}{2\sin B}, \quad u = \frac{c + d\cos B}{2\sin B}. \quad \therefore r\Sigma x = \frac{r(a+b+c+d) - r(a+b-c-d)\cos B}{2\sin B},$$

$$r = \frac{2\sqrt{(abcd)}}{a+b+c+d}, \quad a+c=b+d, \quad \cos B = \frac{a^2 + b^2 - c^2 - d^2}{2(ab+cd)}.$$

$$\therefore \cos B = \frac{(a-c)(a+c) + (b-d)(b-d)}{2(ab+cd)} = \frac{(a+c)(a+b-c-d)}{2(ab+cd)}.$$

$$\therefore r\Sigma x = \frac{\sqrt{(abcd)}}{\sin B} - \frac{\sqrt{(abcd)} \cdot (a+b-c-d)^2}{4(ab+cd)\sin B}, \quad \sin B = \frac{2\sqrt{(abcd)}}{ab+cd},$$

$$4(ab+cd)\sin B = 8\sqrt{(abcd)}.$$

$$\therefore r\Sigma x = \frac{ab+cd}{2} - \frac{(a+b-c-d)^2}{8}. \quad \text{But } d=a+c-d.$$

$$\therefore r\Sigma x = \frac{ab + c(a+c-b)}{2} - \frac{(b-c)^2}{2} = \frac{ab + ac + bc - b^2}{2}$$

$$= \frac{ac + b(a+c) - b^2}{2} = \frac{ac + bd}{2} = \frac{1}{2}AC.BD.$$

207. Proposed by W. W. HART, University High School, Chicago, Ill.

According to Gauss the circumference of a circle can be divided into  $n$  equal parts by ruler and compass only, when  $n$  is a prime of the form  $2^{2^p} + 1$ .

The following construction gives good partial results for  $n$  equals *any* integer. If  $AB$  is the diameter of the circle, and  $C$  is the vertex of the equilateral triangle  $ABC$ , and if  $D$  is a point on  $AB$  at the distance  $2AB/n$  from  $A$ , then draw the line  $CD$  cutting the circle at  $E$  and  $F$ ;  $E$  being the more remote from